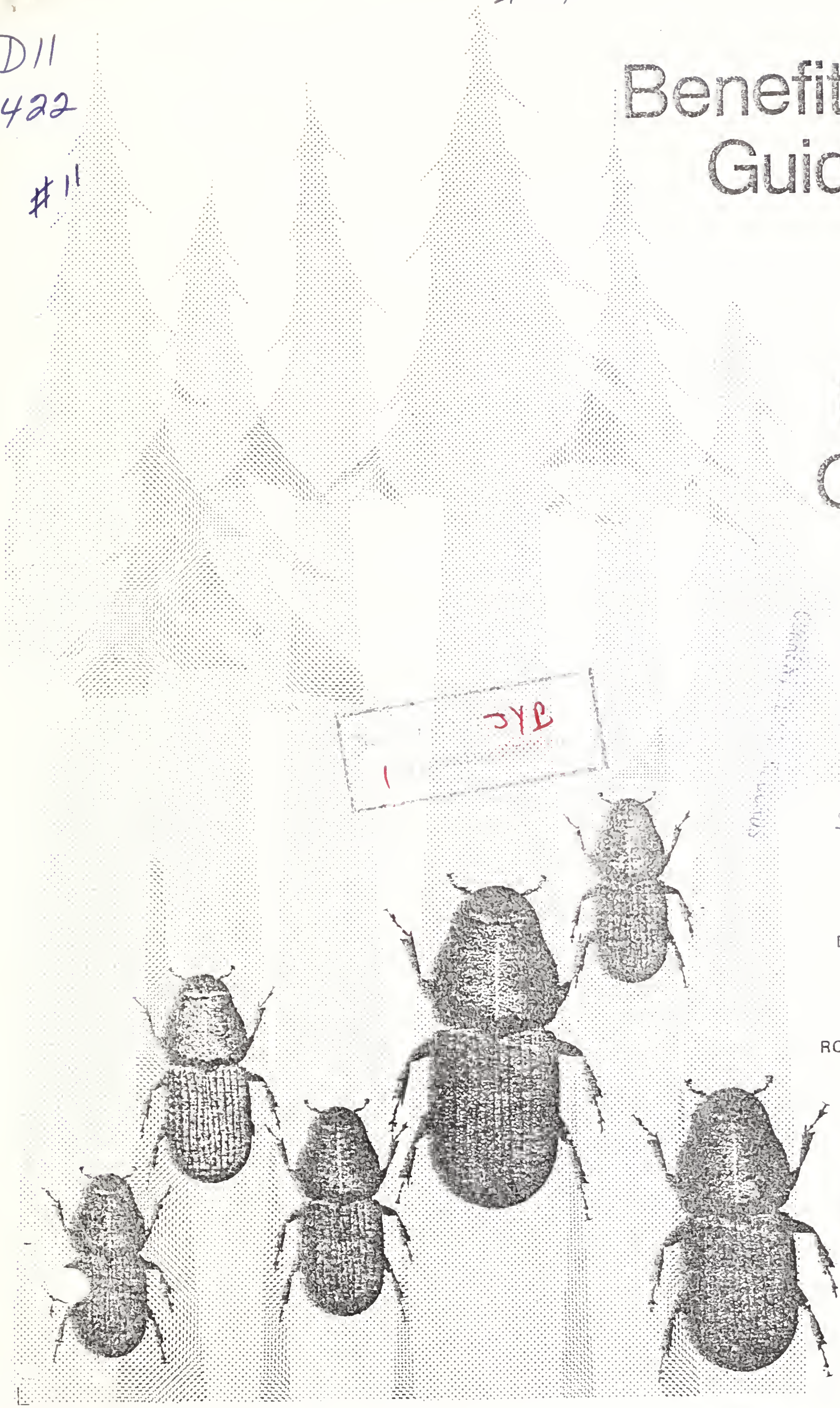
Benefit/Cost Guidelines for Bark Beetle Control



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GUIDELINES FOR ESTIMATING THE ECONOMIC BENEFITS OF MOUNTAIN PINE BEETLE CONTROL PROJECTS

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BACKGROUND

A project proposal for suppression of mountain pine beetle consists of several elements within an Environmental Analysis Report. These elements include a Biological Evaluation, Work Plan proposal, a discussion of the Federal Role for state projects and a Benefit/Cost analysis. This Report provides Regional guidelines for use in conducting the benefit/cost analysis segment. Users and readers are encouraged to submit their suggestions for improving these guidelines to the: Regional Forester, 11177 W. 8th Avenue, P. O. Box 25127, Lakewood, Colorado 80225.

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INTRODUCTION

Losses from a mountain pine beetle (MPB) outbreak within a management unit, (e.g. compartment or Designated Control Area) occur over a number of years, perhaps 10 to 15. Insect management projects designed to stem these losses may also be spread over time. Comparing the benefits (decreases in losses) of a control project with its costs, requires that the comparison be made at a specific point in time - generally the present. To do this, the benefits and costs must be discounted to the present at the appropriate interest rate. If the discounted benefits exceed the discounted costs (B/C > 1), the project is considered worthwhile in terms of economic efficiency.

Economic efficiency is an important and useful decision criterion in evaluating proposed projects. An economic analysis forces the decision maker to consider the question, "Would this be a wise investment of taxpayer's money, or should the investment be foregone?"

From time to time the criterion of economic efficiency will be overridden by non-economic - generally socio-political - conditions. Even when the other considerations prevail, economic efficiency still serves as a reference point in evaluating the tradeoffs between wise investments and the other considerations.

FIVE STEPS TO BENEFIT/COST ANALYSIS

A comprehensive benefit/cost (B/C) analysis for a mountain pine beetle suppression project includes the following five steps:

1. Identify the projected losses of an uncontrolled MPB outbreak. Discount the net value of these losses to the present.

2. Identify the projected losses under a control project. Discount the net value of these losses to the present.

3. Estimate the amount of benefit captured by the control project by subtracting the discounted value of the losses with the control (Step 2) from the discounted value of the uncontrolled losses (Step 1).

4. Estimate the present value of control project costs.

5. Divide the present value of the benefits captured (Step 3) by the present value of the costs (Step 4), to determine the B/C ratio.

A WORD ABOUT ASSUMPTIONS

Before undertaking a B/C analysis the analyst needs to define the geographical area with which he is concerned and develop discrete management <u>objectives</u> and <u>assumptions</u> for the proposal. This is done so that the results can be properly interpreted, alternatives can be compared, and the reader of the analysis can better understand the rationale and context that was used. If the objectives and assumptions are clear, then there is less likelihood of misinterpretation of the data and its analysis, though the assumptions and objectives may be questioned.

LOSS ASSUMPTIONS ON THE MOUNTAIN PINE BEETLE

Normally, an estimate of the severity of current host damage and probable future losses with and without treatment are expressed in the Biological Evaluation. If the loss estimates are not established for a specific control area the following loss assumptions should be utilized. These assumptions are the basis for MPB caused tree mortality, regardless of ownership or management objectives on lands which lack an adequate Biological Evaluation.

<u>Assumption 1</u>

An outbreak can easily last up to ten years. The time span of a given outbreak may be affected by the size of a management unit; on small areas (up to 2 sections), less than 10 years; whereas in large areas (drainage size of several square miles), perhaps up to fifteen years.

Assumption 2

Within a given management unit, such as a Designated Control Area, or compartment (any multiplicity of adjacent stands), the number of stems that will be killed during an outbreak cycle will average 30 percent. The distribution of the loss is not likely to be random.

Assuming a ten-year outbreak with a 30 percent stem loss, the annual mortality averages three percent (30 ÷ 10); with a five-year outbreak and a 30 percent loss, the annual mortality averages six percent (30 ÷ 5).

Assumption 3

In a direct suppression strategy, the planning horizon should be based on the biological potential of the beetle and its host. Up to a ten year planning period may be used in an area if the MPB population is increasing (Knight 1960) and non-infested host material is greater than eleven inches d.b.h.. A one to five year planning period should be used if the MPB population is decreasing and the average d.b.h. of the non-infested host material is less than nine inches. In the nine to eleven inch d.b.h. non-infested range, the planning horizon should be based on brood trend; increasing - five to ten years, static - three to five years and decreasing - one to three years.

Assumption 4

The amount of protection to host material that results from a suppression project is derived from the above assumptions. Thus, if the outbreak is in year five of a ten year outbreak with a stem loss estimated at 30 percent, then 15% of the potential loss (3% per year for 5 years) can be protected; at year two, in a ten year outbreak, up to 24% of the stems can be protected (3% per year for 8 years).

VALUES AT RISK

Values at risk are resources that may be affected by the MPB. These values are quantifiable to a degree. Comments in the following sections on individual values comprise what we feel are

the best ways to "capture" their utility in a B/C analysis. The B/C analysis for a project should include only those values at risk which affect the management objectives of the project area.

Prior to undertaking the mathematics of the analysis it is necessary that the management objectives, inputs and outputs be identified for each value at risk. These values consist of on-site area changes (within the project area) as well as off-site changes (external to the project area) that are a direct result of the on-site effects of MPB. Determine also at what time frame these changes will take place or their effect noted in the marketplace. Thus, what values are at risk, where they are, and when they will take place must be quantified before undertaking the B/C analysis.

Table 1 arrays one way to approach the initial identification of the values at risk. Those that are of quantifiable value are utilized in the B/C analysis. Those not quantifiable but which appear important should be listed separately from the B/C and no attempt should be made to discount their value. Note though whether a benefit or cost will be obtained from them under both control and no control options of the project.

Table 1. Some values at risk, location of effects, time frame for effects and management objective affected.

Value at Risk	On Site Physical Change	Off Site Physical Change	Time-Frame	Management Objectives Affected
Visitor Use	2 Campground Closures	Unknown	Within 5 years	Present usage and fees fore-gone if not replaced. Constitutes 17 percent of CG use in District.
	High stumps, soil compaction from free firewood gatherers, off road vehicle problems		High potential now & next four years for erosion problems unless stablized	Off road vehicle management plan negated unless 1/2 man year time increase allocated to manage erosion and off road vehicle use.
Residential Property	M Tree loss, view degraded	None	Each year for 5 - 7 years	Property value reduced if red tops not cleaned up. Fire hazard increased from slash, loss of blocking view from neighbors.
Timber	Loss of 50 sq. ft. B.A./acre on stands over 120 sq. ft.	Joes sawmill may have to go elsewhere for wood.	Within the next 10 years.	Regulated management on District is changed. New 5 year plan with reduced cut necessary.

Developed and undeveloped residential and commercial property

Losses to mountain pine beetle in residential and commercial areas can be measured in terms of the value of the trees killed. First, estimate the value of the trees. Then, estimate the proportion killed and the year mortality occurs.

The contribution of trees to property value can be estimated as:

Value of trees = (trees + land) - land

The right-hand side of this equation can be solved by using 2 years of market transactions. Obtain a sample of sales price information for comparable residential lots both with and without trees. The difference in sales price is the value of the trees.

Since tree value will vary both with lot size and number of stems per acre, a classification scheme for each property class is in order. We suggest the one presented in Table 2.

Table 2. Contribution of Trees to Property Value (Dollars Per Acre)

Lot Size (Acres)	Trees Per Acre (≥ 6" d.b.h.) 1-10	11-20	21-40	41-60	61-100	101-150	150 +
0 - 1/2	$/acre						
1/2 - 2		$/acre					
2 - 5			$/acre				
5 - 10 *							
10 - ? *							

* Upper limit of lot size should coincide with that used by State revenue personnel in real estate evaluation for property tax purposes.

Once the dollars per acre values of the Table 2 matrix have been calculated, these values can be multiplied by the number of acres in each category to arrive at the total value of trees on residential property in the control project area.

Obviously, only a portion of this total value will be lost to a mountain pine beetle outbreak; and losses will occur over a period of years. Losses can be proportioned over time as follows:

1. Determine planning period (e.g., 10 years).

2. Estimate losses over the planning period (e.g., 30 percent of value).

3. Divide total losses by the planning period to obtain annual loss (e.g., 30% ÷ 10 years = 3%/year).

4. Multiply annual loss (in percent) by the total value of the trees to obtain the annual value loss (e.g., 3% x $100,000 = $3,000).

The underlying assumption of this proportioning procedure is that losses exhibit a linear relationship with time. This is not strictly correct, but it is the best assumption that can be made with existing knowledge.

Normally, the cost of removing beetle killed trees would be added to the annual value loss prior to discounting, and any salvage revenues would be subtracted. However, where timber salvage or firewood operators remove the trees for their salvage value the costs and revenue probably offset each other and the step does not appear to be necessary.

Forest Property

Estimating the losses to MPB in non-residential, non-commercial, forest situations is somewhat more complex than in residential areas. Therefore, a different approach is in order. The following approach is borrowed freely from that suggested by Leuschner and Newton (1974).

Timber

Since mountain pine beetles kill trees outright, growth losses do not have to be considered. Also, if a stumpage market does not exist or if an area is virtually inaccessible, beetle attacks result in zero economic timber losses. There are no potential timber benefits of control. Losses in timber stands, then, are restricted to mortality that is accessible, physically and administratively and for which a market exists or will develop during the planning period; i.e., 10 year Timber Management plan.

As noted in the section on residential property, these losses must be proportioned over the planning period and discounted to the present. The same proportioning procedures as outlined in that section should be used. Of course, the linearity assumptions still apply.

Mature Timber

The value of the mature ($\geq$ rotation age) timber lost to MPB in any one year can be estimated as follows:

Value of loss = (volume affected x green stumpage price) -

(% salvaged x volume affected x salvage price)

Immature Timber

Mortality losses in immature (< rotation age) timber stands can be estimated by projecting stand volume to maturity and discounting stumpage values back to the present. For example, assume that timber in an affected area is 80 years old and the rotation age is 120 years. The value of the loss is determined by (1) projecting the volume at age 120, (2) multiplying the volume by the green stumpage price, and (3) discounting the resulting value for 40 years (120 - 80) at the appropriate interest rate.

Stumpage Prices

Stumpage prices for green and salvage timber should be based on a 5-year average that is weighted by the volume sold, and indexed to the Wholesale Price Index for lumber. The following illustrates the procedure:

(1) Year	(2) Stumpage Price (Current Dollars)	(3) Adjustment Factor *	(4) Stumpage Price (1976 Dollars) (2 x 3)	(5) Volume Sold (MBF)	(6) Weighted Value (4 x 5)
1972	$22	1.39	$31	42,300	$1,311,300
1973	17	1.13	19	188,800	3,587,200
1974	51	1.09	56	151,000	8,456,000
1975	23	1.14	26	190,900	4,963,400
1976	30	1.00	30	119,700	3,591,000
				692,700	$21,908,900

$$\text{Weighted Average} = \frac{\$21{,}908{,}900}{692{,}700} = \$31.63 \text{ or } \$32/\text{MBF}$$

$$\text{* Adjustment Factor} = \frac{\text{Wholesale Price Index (Lumber) for 1976}}{\text{Wholesale Price Index (Lumber) for Adjustment Year}}$$

Reforestation Expense

MPB attacks may precipitate reforestation expenses beyond those normally encountered under the current management program. To the extent that they can be prevented, these additional costs represent benefits of a control project. However, no reforestation expense can be charged to MPB if reforestation costs are the same, whether or not there is an insect attack.

For this analysis an appropriate assumption seems to be that only areas larger than one acre will require artificial regeneration. Areas having scattered mortality can be assumed to regenerate naturally or the mortality viewed simply as a thinning.

Increased reforestation expenses are estimated differently for areas occupied by mature timber than for those areas where the timber is immature.

Mature Timber - Losses occurring through increased reforestation costs are calculated for any one year as:

Value of loss = (cost/acre to reforest attacked area - cost/ac. to reforest unattacked area) x (acres affected)

$$\text{Value of loss} = (\$50/\text{acre} - \$10/\text{acre}) \times 1{,}000 \text{ acres}$$
$$= \$40 \times 1{,}000 = \underline{\$40{,}000}$$

Immature Timber - When immature timber is killed by the MPB, reforestation costs occur sooner than planned. They may also be greater than they would have been had there not been an insect attack. Reforestation expense losses for any one year are estimated as follows:

Value of loss = (cost/ac to reforest attacked area - discounted cost/ac to reforest unattacked area) x (acres affected)

Note that the cost to reforest an unattacked area must be discounted for the number of years to rotation age.

$$\text{Value of loss} = \left[\$50/\text{ac} - \frac{\$10/\text{ac}}{(1 + .10)^{20}}\right] \times (500 \text{ acres})$$
$$= \left[\$50/\text{ac} - \$10/\text{ac}\,(.14864\right] \times (500 \text{ acres})$$
$$= (\$50/\text{ac} - \$1.49/\text{ac}) \times 500 \text{ acres}$$
$$= \$48.51/\text{ac} \times (500 \text{ acres}) = \underline{\$24{,}255}$$

Scenic Quality

The presence of MPB on the landscape has a variety of impacts. On a small scale, foreground, the impact of dying trees (red tops) or dead trees can be dominant in the viewed area. This introduction of color or variety is unacceptable to some due to the psycological impact of introducing dying plant materials. On a large scale, middlegound and background views, the introduction of the red tops is more subdued and their impact is less drastic.

To determine the visual impacts of MPB on the landscape, a thorough Visual Management assessment should be conducted. The foreground and middleground distance zones are the most sensitive to the visual impacts of MPB. Likewise the areas viewed from major roads and housing areas are also highly sensitive. In completing the assessment, determine the visual quality objective and visual absorptive capability of the areas.

Because some MPB activity can be detrimental to the visual management objectives some measure of rehabilitation may be required to lesson the adverse impacts. The number of acres requiring rehabilitation will have to be estimated based upon the course of action directed against the beetle and the present state of the infestation.

Instructions for conducting the Visual Management Assessment are contained in the National Forest Landscape Management Handbooks, Volumes 1 and 2 and FSM 2300.

While the scenic quality and useage data in the Visual Management assessment is of high value no satisfactory system of evaluating its economic worth is available. Therefore, a project benefit/cost analysis should not attempt to go beyond the presentation of the data base. Scenic quality and usage data should be displayed in the following format:

	Foreground (acres)	Middleground (acres)
Sensitivity level 1		
Sensitivity level 2		
Sensitivity level 3		
Visual Quality Objective Retention		
Visual Quality Objective Modification		
Visual Quality Objective Rehabilitation		
Visual Absorption Capability Low		
Visual Absorption Capability Medium		
Visual Absorption Capability High		
Visual Absorption Capability for Red Tops - Low		
Visual Absorption Capability for Red Tops - Medium		
Visual Absorption Capability for Red Tops - High		

	Ownership Class NFS	S&P
Permanent Residents		
Summer Residents		
Developed Recreation Visitor Days		
Dispersed Recreation Visitor Days		

Fire

Fire in beetle killed timber will spread faster, burn hotter and be more costly to suppress than fire in green stands. One of the benefits of a MPB suppression project is that fire control and presuppression costs can be maintained at the pre-MPB buildup level if other conditions remain equal. In order to evaluate the benefit it is necessary to develop and simulate the fire response and costs for the project area under a beetle control and no beetle control situation.

Assumption

To simplify the analysis it is assumed that the occurrence of fire is proportional to the area occupied by a particular fuel model. For example, if 20% of a stand is dead, the probability of fire in dead timber is .2 and .8 in live timber.

Fuel Models

The fuels in an area have a significant affect on fire behavior. A careful consideration of the appropriate fuel models should be made for the area under analysis. Albini (1976) gives detailed descriptions of various fuel models and guides for estimated fire behavior in each fuel model.

Terrain and Weather

Average terrain and weather conditions data should be gathered for the area under consideration. Average slope can be quickly computed from topographic maps. Average wind velocity, temperature and humidity conditions for any area are available from U. S. Weather Service records. Live and dead fuel moisture can be estimated from temperature and relative humidity data.

Initial Attack Time

The average time for initial attack on fires in the control area should be obtained from local records. For example, on private land along the Front Range of Colorado initial attack generally occurs within 20 minutes of the first fire report.

Suppression Resource Requirements

Resources used for fire suppression vary tremendously from fire to fire. Each fire boss will use different combinations of men and equipment for similiar fires. However, in most localities, some group of resources is normally committed to most fires. Along the Front Range of Colorado, most fire suppression is done with hand tools and ground tankers. On more accessible lands tractors replace some of the hand tool requirement. Availability of aerial tankers and their time on station are also suppression costs that vary from area to area. Pre-attack plans and past records are good sources for this information. The estimating guides in the USFS Fireline Handbook are useful in determining how much manpower and equipment are needed for suppression. To develop cost figures, resource requirements for mop up and overhead should be estimated using records of actual fires in the area of consideration.

Suppresssion Costs

Actual suppression costs will vary between areas and agencies. Expected costs should be determined for the project area by converting man and equipment hours to dollars using local rates.

Procedure

There are six steps in estimating the expected cost of fire in an area with and without MPB control. They are:

1. Using historical records (five year average), determine the number of fires expected to occur in the management unit being analyzed.

2. Calculate the area which will be occupied by dead timber and live timber in both the MPB control and no control alternatives in the management unit being analyzed.

3. Using the average terrain, weather, fuel moisture and fuel model(s) for the area being analyzed estimate the expected rate of spread and difficulty of control for fires in both dead and live timber.

4. Estimate the resource requirements for suppression, mop up, and overhead for the expected fire models in the MPB control and no control situation.

5. Convert the resource requirements to dollars using local rates for manpower and equipment.

6. Calculate the expected cost for fire suppression in the no MPB control and MPB control alternative using the following formulas: (% area dead) x (total fires expected annually) x (cost for a fire in dead) = expected annual cost of fire in MPB killed timber.

   (% area green) x (total fires expected annually) x (cost for a fire in green) = expected annual cost of fires in green timber.

Calculate both dead and green costs for MPB control alternative and no control alternative. Subtracting control alternative costs from the no control alternative costs gives expected dollars saved by undertaking the control alternatives.

MOUNTAIN PINE BEETLE CONTROL PROJECT COSTS

Costs applicable to MPB suppression projects include actual Federal, State and private treatment costs (FSM 5281.12) plus pre-suppression and post control surveys, environmental analysis preparation and any necessary treatment precautions that will be a result of the proposed project. Costs should be identified for each year that they will occur.

CALCULATING PRESENT VALUE, NET PRESENT WORTH AND SENSITIVITY ANALYSIS

Once the potential benefits are identified it is necessary to determine the present value of the projects' costs and benefits. By discounting the benefits and costs to the present we are able to account for the time dimension of money. The two formulas presented will be used most of the time. It is recommeded that the user obtain a copy of tables (Lundgren 1971) to minimize the amount of hand calculations necessary.

Formula 1 Discounted Single Payment Multiplier

This multiplier is used to find the present value (PV) now of a future cost or benefit in year n. To determine PV, multiply the future value by the multiplier for the desired interest rate (i) and years (n):

$$PV = \text{future value} \quad \frac{1}{(1 + i)^n}$$

example: What is the present value of a $3,000 direct control cost 5 years from now at a 10% interest rate?

Future value = 3,000
interest rate (i) = .10
years (n) = 5

$$\text{multiplier} = \frac{1}{(1 + .10)^5} = .62092$$

Present value = $3,000 x .62092 = $1,862.76

Formula 2 Discounted Annual Payment Multiplier

This multiplier is used to find the present value (PV) of an annual payment for n years. To determine the present value of this future series of annual payments, multiply the annual payment by the multiplier for the desired interest rate i and years n.

$$PV = \text{annual payment} \quad \frac{(1 + i)^n - 1}{i\ (1 + i)^n}$$

example: What is the present value of a $5,800 annual visitor use benefit during the 10 year plan at a 10% interest rate?

Annual payment = $5,800
interest rate (i) = .10
Years (n) = 10

$$\text{multiplier} = \frac{(1 + .10)^{10} - 1}{.10\ (1 + .10)^{10}} = 6.14457$$

Present value = $5,800 x 6.14457 = $35,638.51

All costs are discounted from the beginning of the year and all benefits are discounted at the end of the year.

Once the present value of the benefits and costs have been calculated, determine the Benefit/Cost Ratio by dividing the present value of benefits by the present value of costs.

After determining the B/C ratio, the analysis should be reviewed to identify those benefits and costs which contribute the greatest influence. If any of these values are suspect in their worth they should be subjected to sensitivity analysis. Sensitivity analysis shows by how much the B/C ratio is affected if the value of a benefit or cost is changed. Only one variable should be sensitized at a time so that the effect of a particular change is not masked by some other change. Sensitivity analysis is easily done since a linear relationship exists between the present value of a benefit or cost, and any other of the same payment type. For example, if an annual benefit is doubled, then its present value is doubled and if its annual value is halved, then its present value is also cut in half.

EXAMPLE BENEFIT/COST ANALYSIS PROBLEM

Situation: The land manager and property owners are concerned about the losses to mountain pine beetle on a 2200 acre mixed ownership unit of forest. A joint biological evaluation conducted in the unit revealed that the MPB population was static and the mean dbh of non-infested hosts was 9.7" $\pm$ 1.8. About 10% of the trees are currently infested or have been killed during the past three years.

On the basis of the biological data a five year planning horizon is selected. Assuming that a 30% loss in stems appears reasonable we can expect an annual loss rate of 4% if no control is taken $\left(\frac{30\% - 10\%}{5 \text{ years}}\right)$

Developed Residential Property

An analysis of property transactions in the County during the past 2 years shows the following mean dollar value per acre (less improvements).

Lot Size	Trees/acre > 6" dbh			
(Acres)	0	41 - 60	61 - 100	101 - 150
0.5 - 2	3,800	4,750	4,560	
2.1 - 5	3,600	4,500	4,320	
5.1 - 10	3,100		3,410	3,255

Within the proposed control area the private property is distributed as follows:

Lot Size	Trees/acre > 6" dbh		
(Acres)	41 - 60	61 - 100	191 - 150
0.5 - 2	6 x $950	14 x $760	
2.1 - 5	3 x $900	2 x $720	
5.1 - 10			1 x $155

The contribution of trees to property value equal to (trees + land) - land is:

Lot Size	Trees/acre > 6" dbh			
Acres)	41 - 60	61 - 100	101 - 150	Total
0.5 - 2	5,700	10,640		16,340
2.1 - 5	2,700	1,440		4,140
5.1 - 10			155	155
				$20,635

Annual loss rate in a no control situation is .04 x $20,635 = $825.40

Annual loss rate in a control situation assuming an 80% efficiency rate is (.04 x .20) x $20,635 = $165.08

Year	Discount Multiplier	No Control	Control
1	.90909	750.36	150.07
2	.82645	682.15	136.43
3	.75131	620.14	124.03
4	.68301	563.76	112.75
5	.62092	512.51	102.50
	Present Value	3,128.92	625.78

or alternatively:

PV of annual loss in a no control situation is annual loss x discounted annual payment multiplier

$$PV = \$825.40 \quad x \quad \left[\frac{(1 \text{ x } 10)^5 - 1}{.10 \ (1 - .10)^5} \right] = \$825.40 \quad x \quad 3.79079 = \$3,128.92$$

PV of annual loss in a control situation is

$$\$165.08 \quad x \quad 3.79079 \quad = \quad \$625.78$$

Timber

Survey data indicates 380 MBF of mature trees on 600 acres is currently infested and 624 MBF immature trees on 1,200 acres of immature timber is infested. Weighted stumpage value is $19.00/MBF. In a no control situation the outbreak is expected to result in the following losses:

Year	Mature Infested MBF	Mature Infested Value	Immature Infested (Volume at maturity*) MBF	Immature Infested (Volume at maturity*) Value
1	380	$ 7,220	768	$14,592
2	600	$11,400	923	$17,537
3	659	$12,521	1,182	$22,458
4	500	$ 9,500	789	$14,991
5	200	$ 3,800	278	$ 5,282
	2,339	$44,441	3,940	$74,960

* 40 years from the beginning of the planning horizon

Under a control situation operating at 80% efficiency and with only minimal inflight of beetle activity the following losses and treatment in MBF are expected:

Mature Timber

Year	Infested MBF	Infested Value	Treated MBF	Non-treated MBF
1	380	$ 7,220	304	76
2	137	$ 2,603	110	27
3	49	$ 931	39	10
4	18	$ 324	14	4
5	7	$ 133	6	1
		$11,229		

Immature Stands

	Volume and Value at Maturity			
	Infested		Treated	Non-treated
Year	MBF	Value	MBF	MBF
1	624	$14,592	499	125
2	225	$ 5,263	180	45
3	81	$ 1,900	65	16
4	29	$ 684	23	6
5	11	$ 226	9	2
		$22,705		

Present value of the control and no control decision for timber.

		No Control		Control	
Year	Discount Multiplier	Infested Value ($)	Present Value ($)	Infested Value ($)	Present Value ($)
1	.90909	7,220	$ 6,564	7,220	$ 6,564
2	.82645	11.400	9,422	2,603	2,151
3	.75131	12,521	9,407	931	699
4	.68301	9,500	6,489	342	234
5	.62092	3,800	2,359	133	83
40*	.02209	74,860	1,654	22,705	502
			$35,895		$10,233

* immature projected to maturity

Scenic Quality

Analysis by the Forest Landscape Planner reveals the following break down of visual attributes:

	Foreground (ac)	Middleground (ac)
Sensitivity Level I	1,400	100
Sensitivity Level II	400	200
Sensitivity Level III	100	
Visual Quality Objective Retention	1,800	100
Visual Quality Objective Modification	300	
Visual Quality Objective Rehabilitation	600	50
Visual Absorption Capability Low	1,700	100
Visual Absorption Capability Medium	50	
Visual Absorption Capability High	350	
Visual Absorption Capability Redtops Low	1,400	
Visual Absorption Capability Redtops Medium	300	100
Visual Absorption Capability Redtops High	50	200

Ownership

	NFS	Private
Permanent Residents	0	36
Summer Residents	0	15
Developed Recreation Visitor Days	0	0
Dispersed Recreation Visitor Days	7,000	13,000

Fire

Albinis' fire model number 2 Timber (Grass and Understory) was used to model fire behavior. The following factors, typical of fire starts in this area, were kept constant for green and dead fuels: Temperature 85° F.; Relative Humidity 20%; 1 hour fuel moisture 4%, local wind at 20 foot 12 mph; windward slope 30%. Green stand fuel moisture for dead was set at 5% and 100% for live. Beetle killed stands were set at 4% fuel moisture dead and 50% fuel moisture live. These values caused fire behavior to respond almost twice as rapid as the historic record indicates. Rate of spread was halved to depict the more real situation experienced on the forest in the past. In two hours, fire burning in green stands would consume about 245 acres; in beetle killed stands about 500 acres. Fire behavior, in terms of crowning, will also be affected by the distribution and density of beetle killed patches.

Attack time in this area is 1 hour for trained crews. The following manning levels represents the resource requirements and costs necessary to accomplish control in four hours.

Green Fuels (196 chains in 2 hours)

Suppression Requirements

Cat at 25 ch/hr $60 hour for 4 hours	$ 240
40 man crew at 1½ ch/hr/man at $10 hour	2,087
Suppression Cost	$ 2,329

Mop up Requirements (392 acre fire)

2 ac/man hour at $10 hour

Mop up Cost	$ 1,960
Resource loss at $423 acre	$165,816
Total cost loss in green fuel	$170,105

Dead Fuels (280 chains in 2 hours)

Suppression Requirements

2 cats at 25 ch/hr, $60 hour, 4 hours	$ 480
80 man crew at $10 hour each - 4 hours	3,200
	$ 3,680

Mop up cost 2 ac/man hour at $10 hour - 800 acre	$ 4,000
Resource damage 800 acre x $352/acre	281,600
Total cost loss in dead fuel	$289,280

Fire Starts

The past five years has averaged 25 fire starts in the 110,000 acre fire control boundary. We can expect

$$\frac{25}{110,000} = \frac{x}{2,200} \; ; \; x = .5$$

0.5 fires per year in the beetle control area. The following table displays the area in percent of dead and live fuels under a control and no control situation for the planning period.

Year	Control Situation Green	Dead	No Control Situation Green	Dead
1	90	10	90	10
2	89	11	86	14
3	88	12	82	18
4	88	12	78	22
5	88	12	74	26

Expected fire costs in a MPB control situation (Dollars)

Year	Green	Dead	Sum	Discount Multiplier	Present Value
1	76,547[1]	17,304[2]	93,851	.90909	85,319
2	75,697	19,034	94,731	.82645	78,290
3	74,846	20,765	95,611	.75131	71,834
4	74,846	20,765	95,611	.68301	65,303
5	74,846	20,765	95,611	.62092	59,367
					360,113

[1] Expected number of fires x percent green fuel x average loss in green fuel .5 x 90% x \$170,105 = \$76,547

[2] Expected number of fires x percent dead fuel x average loss in dead fuel .5 x 10% x \$346,080 = \$17,304

Expected fire costs in a no control situation (Dollars)

Year	Green	Dead	Sum	Discount Multiplier	Present Value
1	76,547	17,304	93,851	.90909	85,319
2	73,145	24,226	97,371	.82645	80,472
3	69,743	31,147	100,890	.75131	75,800
4	66,341	38,069	104,410	.68301	71,313
5	62,939	44,990	107,929	.62092	67,015
					379,919

Project Costs

An estimated 150 man days at $28 per day will be required annually to survey and mark infested trees in the control area. Post control evaluation and supervision will require 25 man days at $44 per day. Manpower requirements will taper off starting in year 3 of the project. Total administrative and overhead costs are not expected to exceed $5,400 in any one year. The primary treatment method will be fell and burn at an estimated cost of $2.00/tree.

	Year				
	1	2	3	4	5
Administration and Overhead	$ 5,400	$ 5,400	$4,700	$3,500	$2,900
Treatment Cost	$28,066	$10,150	$3,640	$1,316	$ 516
Total Cost	$33,466	$15,550	$8,340	$4,816	$3,416
Discount multiplier	1	.90909	.82645	.75131	.68301
Present Value cost	$33,466	$14,136	$6,893	$3,618	$2,333

Total Present Value of Project Costs = $60,446

Project Present Value and Economic Efficiency (Dollars)

	No Control	Control	Difference
Property	3,129	626	2,503
Timber	35,895	20,233	25,662
Fire	379,919	360,113	19,806
Totals	457,593	407,402	47,971

Benefit cost ratio is (47,971 ÷ 60,446) 0.79

The timber value to the benefit cost ratio can be considered conservative since demand for timber in this area is increasing. A new mill to be located in the county next year could cause a significant increase in the value of stumpage of the immature stands. A 10 percent increase in the present value of timber ($28,228) increases the benefit/cost ratio by five percent to .84. Fire is a difficult variable to model economically and a 20 percent variation in the present value appears reasonable (Range of $15,845 to $23,767) results in an 8 percent variation of the benefit/cost ratio (0.73 - 0.86).

With the assumptions utilized the project is not economically efficient. The non monetary value of scenery indicates that 64 percent of the view is highly sensitive, 77% of the scenery has a low ability to absorb the contrasting redtop color within the landscape. The 20,000 recreation visitor day use that this area receives indicates a high level of use within a relatively small area. If the scenic value and recreation use within the area has a present value greater than $12,475 (the amount of economic benefits necessary to equal costs) then the project becomes economically efficient with the assumptions utilized.

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